

Zero Retries issue 0082 2023-01-20

Zero Retries is an independent newsletter about technological innovation in Amateur Radio. Zero Retries promotes Amateur Radio as (literally) a license to experiment with radio technology.

About Zero Retries

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In this issue:

- Request To Send
 - Brave New World (Soon Enough) - Artificial Intelligence in Radio Technology
 - ZR > BEACON
 - Join the *Fun* on Amateur Radio
 - Closing The Channel
-

Request To Send

In Zero Retries, I only rarely, and reluctantly, wade into the politics of (US) Amateur Radio. I prefer to spend my time and the space in Zero Retries, *and the attention of Zero Retries subscribers* promoting technological innovation and “Zero Retries Interesting” topics. Zero Retries is a completely independent publication, so it’s one of the few Amateur Radio publications that *can* report on this issue I’m about to discuss.

Amateur Radio needs more, and more diverse people reaching out to the current generation that may be interested in Amateur Radio. Ria Jairam N2RJ is one such person.

Thus I feel strongly that the ARRL Board sanctioning ARRL Hudson Division Director Ria Jairam N2RJ over the issue of her new book - [Ham Radio Technician Class Test Study Guide 2022 - 2026: Everything You Need to Know to Get Your Technician License](#) is a significant error.

If you’re an ARRL member, I urge you to read this article by Bruce Perens K6BP - [Director Ria Jairam “Recused” by ARRL, and It Seems Political To Me](#). Don’t just take K6BP’s descriptions verbatim, look at the [relevant minutes](#) and the [ARRL report on the incident that K6BP posted](#). Also consider the history of the ARRL Board’s similar actions (more ably described by K6BP).

Perhaps N2RJ didn’t observe all the minutiae of potential conflict of interest given her position as a Board member of the ARRL. Having had a recent conflict of interest issue with a large organization (not ARRL), I’m sympathetic to N2RJ on that issue.

In the end, N2RJ’s “sin” for which she was sanctioned by the other members of the ARRL Board (nearly unanimously) was to *write a book* to help people pass the Amateur Radio Technician exam, and that *her* book (not published by the ARRL) “competed” with an ARRL book on how to pass the Technician exam.

Passing the Technician exam is, in the end, answering enough multiple choice questions correctly. Given that, *all* books on how to pass the Technician exam will inevitably have substantial similarities.

Parse the bigger picture of this for a bit. A younger (than average US Amateur Radio Operator), enthusiastic, bright, well-spoken, techie woman wrote a book about getting licensed for Amateur Radio *from her perspective*. Such a book on passing the Technician exam is unique *because N2RJ wrote it*.

N2RJ is a tireless promoter of Amateur Radio on her [website](#), social media and [her YouTube channel](#). From personal discussions, I know that N2RJ inspires a lot of young people, especially women, who, through N2RJ's advocacy, can *maybe* see themselves represented in Amateur Radio.

If you're an ARRL member, you have some standing in this issue. Thus I urge ARRL members to [contact your ARRL Division Director](#). Doing so is the only way to influence this decision. I've sent my letter of protest to my ARRL director.

Disclaimers:

- *I haven't read N2RJ's book... but as a General, I'm not the target audience.*
- *As I related in Zero Retries 0070 - Big Project for Organization X - Now It Can Be Told - I did work for hire for ARRL in 2022 in contributing to the 100th Edition of the ARRL handbook.*
- *I am a (dues paid) member of the ARRL.*

de Steve N8GNJ

Brave New World (Soon Enough) - Artificial Intelligence in Radio Technology

You likely overlooked that I made a change in the “masthead statement” for Zero Retries in this issue. Previously, it was

Zero Retries is an independent newsletter about technological innovation in Amateur Radio.

As of this issue, I've added this additional sentence:

Zero Retries promotes Amateur Radio as (literally) a license to experiment with radio technology.

A small part of that changed statement was the result of an exchange of emails with a subscriber that expressed dismay that I offered my opinion that VARA FM was technologically superior to “classic” packet radio. I tried to explain that Zero Retries isn't a “packet radio” newsletter (though I discuss it a lot) but rather, I strive for Zero Retries to highlight the technological innovation that *is occurring* in Amateur Radio.

Thus, I thought including that second sentence would help clarify that Zero Retries is intended to be an ongoing discussion of technological innovation *and experimentation* in Amateur Radio.

Generative Artificial Intelligence (GAI)

The primary reason that additional sentence seemed appropriate is a trend I'm seeing for what I think will be a tsunami of innovation in Amateur Radio (and radio technology). That transformation will result from experimentation with Artificial Intelligence (AI) being applied to Amateur Radio operations and technology¹.

Apologies to those that haven't seen it, but the “television” series [The Expanse](#) somewhat illustrates the ultimate evolution of this trend. When the primary characters want to communicate externally from their ship (the Rocinante), they just state who they want communicate with. No mention of frequencies², codes, modes, systems, antennas, relay nodes, etc. is necessary. The ship's AI system figures out how best to accomplish the communication and gets it done. Yes, that ease of communication³ is mostly a plot device, but it's an excellent illustration of the application of AI to radio / communications technology. Soon enough, we're going to have that kind of capability, mostly because we've figured out how to effectively use the vast amounts of compute power we now have available to implement usable AI and apply that to Software Defined Radio (SDR) systems.

The primary inspiration for this article was an article in the 2023-01-16 issue of the New York Times - [Alarmed](#)

by [A.I. Chatbots, Universities Start Revamping How They Teach](#). That article discusses the use of OpenAI's project called [ChatGPT](#) and how amazingly capable it is at generating text that's nearly indistinguishable from text written by humans. One professor relates their discovery of the use of ChatGPT in their classes for a paper assignment... not because the paper one student turned in was poor in comparison to the rest of the students... because it was *so much better!*

Here's the stunner (to me) - the article reminded me that ChatGPT was opened for use in *November* - three short months ago... and it's *already this capable!* To me, this signals that the era of AI is *now* upon us... ready or not. AI is being applied to solving problems in ways we can imagine, and applied in ways we can't yet imagine. One thing we've learned the hard way about such new capabilities is that we need to stretch our imaginations big enough to try to imagine the (previously) unimaginable.

Yet Another Plug for Digital Library of Amateur Radio & Communications (DLARC)

Before I turn to the main thrust of this article, ChatGPT is so capable because OpenAI trained it on incredible amounts of (human generated) text. Thus, imagine how good something like ChatGPT could be as a virtual, omniscient mentor⁴ of Amateur Radio by training on the rapidly growing Amateur Radio material that's available on Internet Archive's [Digital Library of Amateur Radio & Communications \(DLARC\)](#). Thus, it's important to get a lot of good, representative material about Amateur Radio into DLARC. Reminder to self - resume my personal contributions to DLARC soon.

AI Applied to Radio Technology

I credit Dr. Robert "Dr. Bob" McGwier N4HY for "waking me up" to the ~~possibility~~ *inevitability* of AI being applied to radio technology. I cannot find the reference now⁵, but at the end of a presentation, N4HY said something to the effect of "If you think *this* is impressive, let me tell you *that you haven't seen anything yet* - wait until you see what AI is *going* to do in *radio communications*".

The above video isn't the one I'm referencing, but it's instructive.

For me, N4HY's casual reference "clicked" - **he's absolutely right**⁶. Current generation radio technology is already software-based, but it's based on "static algorithms" - developing waveforms, using various frequencies, distributing load between nodes, all based on things that humans have imagined in advance and have implemented in algorithms. But nothing really resembling "intelligence"⁷.

Once AI is turned loose on radio technology, it will be a brave new world for radio technology and communications.

If you think that this idea is fantasy, especially in Amateur Radio, consider this - if you think that AI is only usable because of massive compute power available on server farms and accessible via always-on Internet, that's mostly true. However, AI is rapidly moving "downscale" [onto embedded platforms](#). That is simultaneous with embedded platforms becoming increasingly capable. For example, the Raspberry Pi 4 was introduced in *mid-2019* with these compute capabilities:

- Quad core Cortex-A72 (ARM v8) System on Chip (SOC)
- 64-bit capable
- 1.5GHz clock speed
- 8GB LPDDR4-3200 SDRAM

All for \$75 (list, from Raspberry Pi approved vendors).

It will soon be three years since the debut of the Raspberry Pi 4, and computer technology continuously advances. Undoubtedly there's a [Raspberry Pi 5 in development](#) with even greater compute capability... but apparently we won't see it in 2023. While Raspberry Pi is the best (in my opinion) hobbyist embedded computer appropriate for Amateur Radio use, [it certainly isn't the only such unit](#).

So what *could* AI-enabled Amateur Radio look like? Here are some ideas

Receives All, Understands All

We've barely scratched the surface of Software Defined Receivers (SDRX). With the right software, they can receive anything transmitted, but again, what SDRX can do at the moment is static depending on its prior programming (by humans). An AI SDRX might receive everything using hardware such as "AllVU" (described in Zero Retries 0079) to receive all Amateur Radio VHF / UHF bands, and figure out what the radio environment is moment-to-moment.

An example might be that the AI running N8GNJ notices that N8GNJ-10, using VARA FM transmits on 145.09, communicating with N8GNJ-15 once every 20 minutes or so. The AI learns the schedule of N8GNJ-10 and N8GNJ-15 and slips some packet radio communications "between" those observed communications on 145.09. When the AI notices energy in its receiver(s) that doesn't fit any known modulation method, it tries to analyze the signal similar to a human would... just hundreds or thousands of times faster.

Most Capable Communication Method in Common

I'll guess many of you tire of me citing VARA FM as a highly capable Amateur Radio data communications system, but one of its best attributes is its ability to negotiate between two VARA FM stations for the fastest, most reliable set of parameters that are common to the two stations. But that's only possible in the tightly constrained environment of two VARA FM stations. An AI would be able to use *all* modes available (packet radio, fldigi, VARA, perhaps even RTTY) and choose the one that works best - most robust for a marginal path, highest throughput for a good path, shortest transmissions for a congested channel, constrained signal for a path such as a repeater (such as only using it at night when there's no human use of the repeater), etc.

Best Spectrum to Use

Automated choice of spectrum isn't a new idea - it's the idea behind [trunked radio systems](#) (late 1970s), and more recently, [cognitive](#) techniques already in use by Wi-Fi and Citizens Broadband Radio Service (CBRS). What could be different about the use of AI and choice of Amateur Radio spectrum is the speed of choice of spectrum. What band should you use to communicate? The last communication your station had with KZ0XYZ was on 52.75 MHz using FSQ mode on SSB, so the AI tries that mode first, and if it can establish communication, it handshakes with KZ0XYZ's AI to see what other capabilities the two stations have in common. The AI can also factor in potential relay stations, weather / propagation, satellites in range, etc.

Entirely New Modes

While it's probably not a capability for an embedded AI like what I'm imagining here, entirely new modes could be developed that humans can't quite imagine yet. We've seen this pattern in AI previously - the AI is constrained by various parameters and then iteratively tries various solutions. At times this approach developed solutions, or answers to questions, or found patterns that simply weren't understandable by humans. Figuring out how to interact productively with something that's smarter (at least in technology domains) than most of us are is going to be an interesting challenge for us humans.

Science Fiction? Not Really.

If you still think that all of the above is essentially science fiction... actually it's science *fact* - from four years ago now, proved out in the final [DARPA Spectrum Collaboration Challenge](#):

What is the Spectrum Collaboration Challenge?

Across the nation and around the world, the wireless revolution is fueling a voracious demand for access to the radio frequency (RF) spectrum. In the civilian sector, consumer devices from smartphones to wearable fitness recorders to smart kitchen appliances are competing for bandwidth. In the military there is a growing reliance on unmanned platforms, from underwater sensors to satellites, and a push for broadband connectivity for every member of every Service. Managing this increasing demand, while combating what appears to be a looming scarcity of RF spectrum is a serious problem for our nation.

Today's approach, which is nearly a century old, isolates wireless systems by dividing the spectrum into rigid exclusively licensed bands, which are allocated over large, geographically defined regions. This approach rations access to the spectrum in exchange for the guarantee of interference-free communication. However, it is human-driven and not adaptive to the dynamics of supply and demand. At any given time, many allocated bands are unused by licensees while other bands are overwhelmed, thus squandering the spectrum's enormous capacity and unnecessarily creating conditions of scarcity.

The Spectrum Collaboration Challenge (SC2), aimed to ensure that the exponentially growing number of military and civilian wireless devices would have full access to the increasingly crowded electromagnetic spectrum. Competitors reimaged spectrum access strategies and developed a new wireless paradigm in which radio networks autonomously collaborated and reasoned about how to share the RF spectrum, avoiding interference and jointly exploiting opportunities to achieve the most efficient use of the available spectrum. SC2 teams developed these breakthrough capabilities by taking advantage of recent advances in artificial intelligence (AI) and machine learning, and the expanding capacities of software-defined radios. Ultimately this competition aimed not only to challenge innovators in academia and business to produce breakthroughs in collaborative AI, but also to catalyze a new spectrum paradigm that will usher in an era of spectrum abundance.

The above is courtesy of the Internet Archive Wayback Machine [snapshot from 2021-04-19](#).

Why do I think this applies to Amateur Radio?

- Again, in my opinion, Amateur Radio is literally a license to experiment with radio technology.
 - The software capability for AI to be applied to radio technology exists - it's off the shelf, and almost certainly open source.
 - Software Defined Radio transmitters and receivers capable of being used by the above software exist and are simultaneously becoming less expensive and increasing in their capabilities.
 - Inexpensive compute power for embedded AI is steadily improving in cost / performance.
 - Amateur Radio is seeing a steady increase in curious, technical, and capable people and I don't think it's much of a stretch of imagination to envision some of them making use of these technologies. Someone's gonna start doing this, perhaps one of the 205 new Amateur Radio Operators⁸ licensed at [DEFCON 22](#).
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ZR > BEACON

- [\[National Instruments\] Considers a Sale](#)

NI said Friday that it has been approached by potential buyers and that its board of directors has begun a review of its strategic options.

Uh Oh... This news is Zero Retries Interesting because National Instruments (apparently they prefer “NI” now) owns [Ettus Research](#), including the very capable Universal Software Radio Peripheral (USRP) products. USRP is widely used in radio technology development, including a number of Amateur Radio Operators and Amateur Radio research. Corporate takeovers have a disturbing history of killing innovative products such as ER and USRP because they’re not obscenely profitable.

Join the *Fun* on Amateur Radio

If you’re not yet licensed as an Amateur Radio Operator, and would like to join the fun by *literally having a license to experiment with radio technology*, check out

Join the Fun on Amateur Radio for some pointers.

Closing the Channel

In its mission to highlight technological innovation in Amateur Radio, promote Amateur Radio to techies as a literal license to experiment with wireless technology, and make Amateur Radio more relevant to society in the 2020s and beyond, Zero Retries is published via email and web, and is available to anyone at no cost. Zero Retries is proud *not to participate* in the Amateur Radio Publishing Industrial Complex, which hides Amateur Radio content behind paywalls.

My ongoing *Thanks* to:

- Tina Stroh KD7WSF for, well, *everything*!
- Pseudostaffers [Dan Romanchik KB6NU](#) and [Jeff Davis KE9V](#) for continuing to spot, and write about “Zero Retries Interesting” items on their blogs that I don’t spot on my own.
- [Amateur Radio Weekly](#) consistently surfaces “Zero Retries Interesting” stories.
- Andreas Spiess HB9BLA’s YouTube Channel - [HB9BLA Wireless](#) features Zero Retries Interesting content.
- The [Substack email publishing platform](#) makes Zero Retries possible. I recommend it for publishing newsletters.

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If you’re a fellow smart person that uses **RSS**, there *is* an **RSS feed for Zero Retries**.

Zero Retries (N8GNJ) is on Mastodon - n8gnj@mastodon.radio - just click:

[Zero Retries / N8GNJ on Mastodon](#)

Email issues of Zero Retries are “instrumented” by [Substack](#) to gather basic statistics about opens, clicking links, etc. I don’t use such information in any way other than seeing that most subscribers actually do read Zero Retries.

More bits from Steve Stroh N8GNJ:

- [SuperPacket blog](#) - *Discussing new generations of Amateur Radio Data Communications - beyond Packet Radio (a precursor to Zero Retries)*
- [N8GNJ blog](#) - *Amateur Radio Station N8GNJ and the mad science experiments at N8GNJ Labs - Bellingham, Washington, USA*

Thanks for reading!

Steve Stroh N8GNJ / WRPS598 (He / Him / His)

These bits were handcrafted in beautiful Bellingham ([The City of Subdued Excitement](#)), Washington, USA.

2023-01-20

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[1](#)

Tom Salzer K7JT did a great job examining the “educational” aspects of AI for Amateur Radio, specifically the use of ChatGPT - [Does artificial intelligence have a place in amateur radio?](#)

[2](#)

Admittedly, there is the occasional mention of “tight beam” or “laser”.

[3](#)

I’m also an unabashed fanboy of the personal communication devices that are shown in The Expanse. Those are entirely fictional using Computer Graphics Imagery (CGI) except for the handheld piece of plexiglas being edge lit by an LED.

[4](#)

If we ever get to the point of being able to use something like ChatGPT trained on a specific set of data, I’d love to try creating a virtual [Wayne Green W2NSD](#) by training on all of his editorials over the decades - then ask it questions 🤖.

[5](#)

While YouTube’s algorithms are good at recommending videos to watch, they aren’t so good at finding fleeting references like what I’m trying to locate.

6

I don't remember if N4HY mentioned the DARPA Spectrum Collaboration Challenge, or not, but mentioning the SCC at this point in the article would have been a spoiler.

7

Secretive Three Letter Agencies of the US Government notwithstanding...

8

See <http://www.palomararc.org/Scope/sep14scope.pdf>, pages 8 and 9 for details.